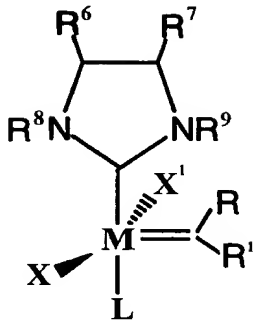
What is claimed is:

1. A compound of the formula



wherein:

M is ruthenium or osmium;

X and X^1 are each independently an anionic ligand;

L is a neutral electron donor ligand; and,

R, R^1 R^6, R^7, R^8, and R^9 are each independently hydrogen or a substituent selected from the group consisting of C_1-C_{20} alkyl, C_2-C_{20} alkenyl, C_2-C_{20} alkynyl, aryl, C_1-C_{20} carboxylate, C_1-C_{20} alkoxy, C_2-C_{20} alkenyloxy, C_2-C_{20} alkynyloxy, aryloxy, C_2-C_{20} alkoxycarbonyl, C_1-C_{20} alkylthiol, aryl thiol, C_1-C_{20} alkylsulfonyl and C_1-C_{20} alkylsulfinyl, the substituent optionally substituted with one or more moieties selected from the group consisting of C_1-C_{10} alkyl, C_1-C_{10} alkoxy, aryl, and a functional group selected from the group consisting of hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen.

2. The compound as in claim 1 wherein:

M is ruthenium;

L and L^1 are each independently selected from the group consisting of phosphine, sulfonated phosphine, phosphite, phosphinite, phosphonite, arsine, stibine, ether, amine, amide, imine, sulfoxide, carboxyl, nitrosyl, pyridine, and thioether; and,

X and X^1 are each independently hydrogen, halide, or a substituent selected from the group consisting of C_1-C_{20} alkyl, aryl, C_1-C_{20} alkoxide, aryloxide, C_3-C_{20} alkyldiketonate, aryldiketonate, C_1-C_{20} carboxylate, arylsulfonate, C_1-C_{20} alkylsulfonate,

C_1-C_{20} alkylthiol, aryl thiol, C_1-C_{20} alkylsulfonyl, and C_1-C_{20} alkylsulfinyl, the substituent optionally substituted with one or more moieties selected from the group consisting of C_1-C_{10} alkyl, C_1-C_{10} alkoxy, aryl and halide.

3. The compound as in claim 1 wherein:

M is ruthenium;

X and X^1 are each independently selected from the group consisting of halide, CF_3CO_2, CH_3CO_2, CFH_2CO_2, $(CH_3)_3CO$, $(CF_3)_2(CH_3)CO$, $(CF_3)(CH_3)_2CO$, PhO, MeO, EtO, tosylate, mesylate, and trifluoromethanesulfonate;

L is a phosphine of the formula $PR^3R^4R^5$, where R^3, R^4, and R^5 are each independently aryl, C_1-C_{10} alkyl, or cycloalkyl;

R is hydrogen; and,

R^1 is phenyl or vinyl, optionally substituted with one or more moieties selected from the group consisting of C_1-C_5 alkyl, C_1-C_5 alkoxy, phenyl, and a functional group selected from the group consisting of hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen.

4. The compound as in claim 3 wherein

X and X^1 are each chloride;

L is selected from the group consisting of -P(cyclohexyl)$_3$, -P(cyclopentyl)$_3$, -P(isopropyl)$_3$, and -P(phenyl)$_3$; and,

R^1 is phenyl or $-C{=}C(CH_3)_2$;

5. The compound as in claim 4 wherein R^6 and R^7 together form a cycloalkyl or an aryl.

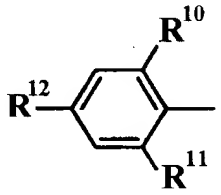
6. The compound as in claim 4 wherein R^6 and R^7 together form a cyclopentyl or a cyclohexyl moiety.

7. The compound as in claim 4 wherein R^6 and R^7 are the same and are hydrogen or phenyl.

8. The compound as in claim 4 wherein R^8 and R^9 are each independently a substituted or unsubstituted aryl.

9. The compound as in claim 4 wherein R^8 and R^9 are the same and are phenyl.

10. The compound as in claim 4 wherein R^8 and R^9 are each independently of the formula

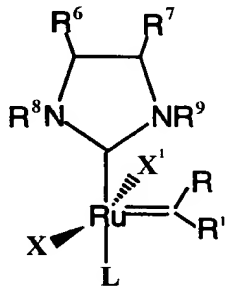


wherein

R^{10}, R^{11}, and R^{12} are each independently hydrogen, C_1-C_{10} alkyl, C_1-C_{10} alkoxy, aryl, or a functional group selected from hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen.

11. The compound as in claim 10 wherein R^{10}, R^{11}, and R^{12} are each independently hydrogen, methyl or isopropyl.

12. A compound of the formula



wherein:

X and X^1 are each chloride;

L is selected from the group consisting of -P(cyclohexyl)$_3$, -P(cyclopentyl)$_3$, -P(isopropyl)$_3$, and -P(phenyl)$_3$;

R is hydrogen;

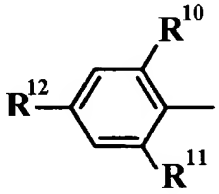
R^1 is phenyl or vinyl, optionally substituted with one or more moieties selected from the group consisting of C_1-C_5 alkyl, C_1-C_5 alkoxy, phenyl, and a functional group selected from the group consisting of hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen;

R^6 and R^7 are each independently hydrogen, phenyl, or together form a cycloalkyl or an aryl optionally substituted with one or more moieties selected from the group consisting of C_1-C_{10} alkyl, C_1-C_{10} alkoxy, aryl, and a functional group selected from the group consisting of hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen; and

R^8 and R^9 are each is independently C_1-C_{10} alkyl or aryl optionally substituted with C_1-C_5 alkyl, C_1-C_5 alkoxy, aryl, and a functional group selected from the group consisting of hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen.

13. The compound as in claim 12 wherein R^8 and R^9 are each is independently a cycloalkyl or a phenyl optionally substituted with C_1-C_5 alkyl, C_1-C_5 alkoxy, or halogen.

14. The compound as in claim 12 wherein R^8 and R^9 are each independently of the formula

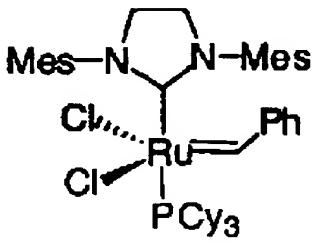


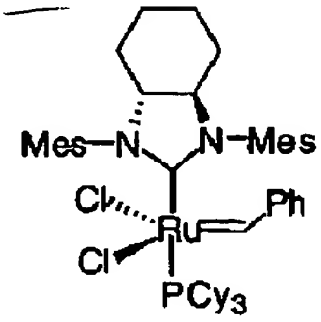
wherein

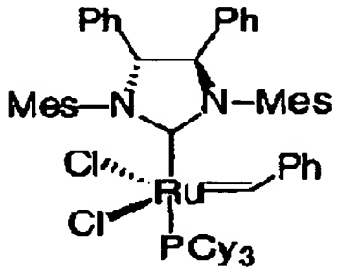
R^{10}, R^{11}, and R^{12} are each independently hydrogen, C_1-C_{10} alkyl, C_1-C_{10} alkoxy, aryl, or a functional group selected from hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen.

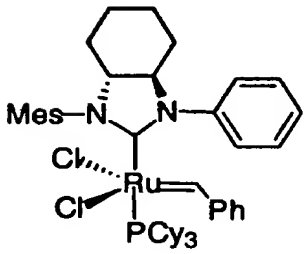
15. The compound as in claim 14 wherein R^{10}, R^{11}, and R^{12} are the same and are each methyl.

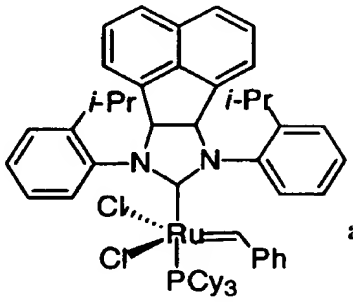
16. The compound as in claim 12 selected from the group consisting of



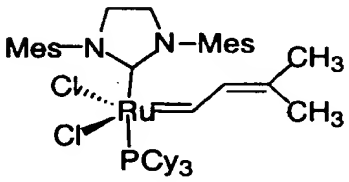




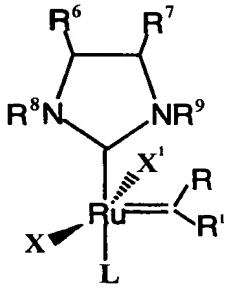




and



17. A compound of the formula



wherein:

X and X^1 are each chloride;

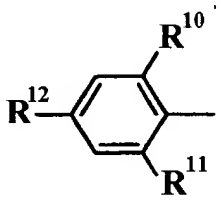
L is selected from the group consisting of -P(cyclohexyl)$_3$, -P(cyclopentyl)$_3$, -P(isopropyl)$_3$, and -P(phenyl)$_3$;

R is hydrogen;

R^1 is phenyl or -C=C$(CH_3)_2$;

R^6 and R^7 are each independently hydrogen, phenyl, or together form a cyclopentyl or cyclohexyl; and

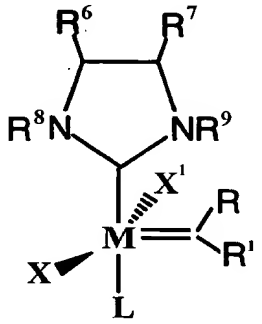
R^8 and R^9 are each is independently of the formula



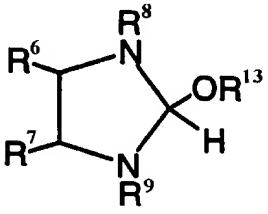
wherein

R^{10}, R^{11}, and R^{12} are each independently hydrogen, methyl, ethyl, propyl, isopropyl, hydroxyl, and halogen.

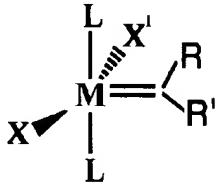
18. A method for making a compound of the formula



comprising contacting



with



wherein:

M is ruthenium or osmium;

X and X^1 are each independently an anionic ligand;

L is a neutral electron donor ligand;

R, R^1 R^6, R^7, R^8, and R^9 are each independently hydrogen or a substituent selected from the group consisting of C_1-C_{20} alkyl, C_2-C_{20} alkenyl, C_2-C_{20} alkynyl, aryl, C_1-C_{20}

carboxylate, C_1-C_{20} alkoxy, C_2-C_{20} alkenyloxy, C_2-C_{20} alkynyloxy, aryloxy, C_2-C_{20} alkoxycarbonyl, C_1-C_{20} alkylthiol, aryl thiol, C_1-C_{20} alkylsulfonyl and C_1-C_{20} alkylsulfinyl, the substituent optionally substituted with one or more moieties selected from the group consisting of C_1-C_{10} alkyl, C_1-C_{10} alkoxy, aryl, and a functional group selected from the group consisting of hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen; and,

R^{13} is C_1-C_{20} alkyl or aryl.

19. The method as in claim 18 wherein

M is ruthenium;

X and X^1 are each chloride;

L is selected from the group consisting of -P(cyclohexyl)$_3$, -P(cyclopentyl)$_3$, -P(isopropyl)$_3$, and -P(phenyl)$_3$;

R is hydrogen;

R^1 is phenyl or -C=C(CH$_3$)$_2$;

R^6 and R^7 are each independently hydrogen, phenyl, or together form a cyclopenyl or cyclohexyl; and,

R^8 and R^9 are each independently a substituted or unsubstituted aryl.

20. The method as in claim 19 wherein R^{13} is t-butyl.

21. The method as in claim 18 wherein

M is ruthenium;

X and X^1 are each chloride;

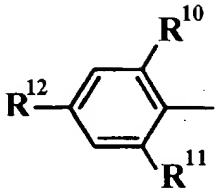
L is selected from the group consisting of -P(cyclohexyl)$_3$, -P(cyclopentyl)$_3$, -P(isopropyl)$_3$, and -P(phenyl)$_3$;

R is hydrogen;

R^1 is phenyl or -C=C(CH$_3$)$_2$;

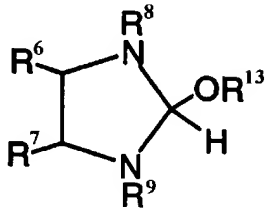
R^6 and R^7 together form a cycloalkyl group; and

R^8 and R^9 are the same and are each of the formula

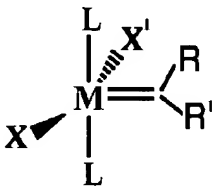


wherein

R^{10}, R^{11}, and R^{12} are each independently hydrogen, methyl, ethyl, propyl, isopropyl, hydroxyl, and halogen.

22. The method as in claim 21 wherein  is optically active.

23. A method for making a metathesis catalyst comprising contacting a compound of



the formula with an imidazolidine whereby the imidazolidine replaces one of the L ligands wherein:

M is ruthenium or osmium;

X and X^1 are each independently an anionic ligand;

L is a neutral electron donor ligand; and,

R and R^1 are each independently hydrogen or a substituent selected from the group consisting of C_1-C_{20} alkyl, C_2-C_{20} alkenyl, C_2-C_{20} alkynyl, aryl, C_1-C_{20} carboxylate, C_1-C_{20} alkoxy, C_2-C_{20} alkenyloxy, C_2-C_{20} alkynyloxy, aryloxy, C_2-C_{20} alkoxycarbonyl, C_1-C_{20} alkylthiol, aryl thiol, C_1-C_{20} alkylsulfonyl and C_1-C_{20} alkylsulfinyl, the substituent optionally substituted with one or more moieties selected from the group consisting of C_1-C_{10} alkyl, C_1-C_{10} alkoxy, aryl, and a functional group selected from the group consisting of hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen.

24. The method as in claim 23 wherein the imidazolidine is formed by

contacting a secondary diamine with ammonium tetrafluoroborate to form an imidazolium salt; and

contacting the imidazolium salt with an alkyloxide to form the imidazolidine.

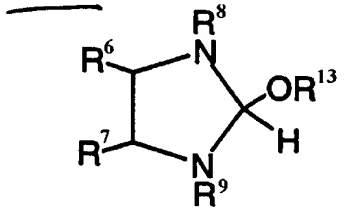
25. The method as in claim 24 wherein the secondary diamine is formed by

contacting a diketone with an amine to form a diimine and

hydrogenating the diimine to form the secondary di-amine;

26. The method as in claim 24 wherein the alkyloxide is t-butoxide.

27. The method as in claim 24 wherein the imidazolidine is of the formula



wherein

R^6, R^7, R^8, and R^9 are each independently hydrogen or a substituent selected from the group consisting of C_1-C_{20} alkyl, C_2-C_{20} alkenyl, C_2-C_{20} alkynyl, aryl, C_1-C_{20} carboxylate, C_1-C_{20} alkoxy, C_2-C_{20} alkenyloxy, C_2-C_{20} alkynyloxy, aryloxy, C_2-C_{20} alkoxycarbonyl, C_1-C_{20} alkylthiol, aryl thiol, C_1-C_{20} alkylsulfonyl and C_1-C_{20} alkylsulfinyl, the substituent optionally substituted with one or more moieties selected from the group consisting of C_1-C_{10} alkyl, C_1-C_{10} alkoxy, aryl, and a functional group selected from the group consisting of hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen; and,

R^{13} is C_1-C_{20} alkyl or aryl.

28. The method as in claim 27 wherein

M is ruthenium;

X and X^1 are each chloride;

L is selected from the group consisting of -P(cyclohexyl)$_3$, -P(cyclopentyl)$_3$, -P(isopropyl)$_3$, and -P(phenyl)$_3$;

R is hydrogen; and

R^1 is phenyl or vinyl, optionally substituted with one or more moieties selected from the group consisting of C_1-C_5 alkyl, C_1-C_5 alkoxy, phenyl, and a functional group selected from the group consisting of hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen.

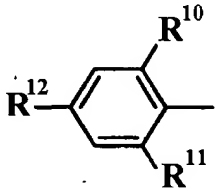
29. The method as in claim 28 wherein R^1 is phenyl or -C=C(CH$_3$)$_2$ and R^{13} is t-butoxide.

30. The method as in claim ~~28 wh~~erein

R^6 and R^7 are each independently hydrogen, phenyl, or together form a cycloalkyl or an aryl optionally substituted with one or more moieties selected from the group consisting of C_1-C_{10} alkyl, C_1-C_{10} alkoxy, aryl, and a functional group selected from the group consisting of hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen; and

R^8 and R^9 are each independently either substituted or unsubstituted aryl.

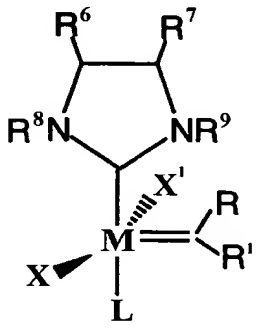
31. The method as in claim 30 wherein R^8 and R^9 are each is independently of the formula



wherein

R^{10}, R^{11}, and R^{12} are each independently hydrogen, methyl, ethyl, propyl, isopropyl, hydroxyl, and halogen.

32. A method for performing a metathesis reaction comprising contacting an olefin with a compound of the formula



wherein:

M is ruthenium or osmium;

X and X^1 are each independently an anionic ligand;

L is a neutral electron donor ligand; and,

R, R^1 R^6, R^7, R^8, and R^9 are each independently hydrogen or a substituent selected from the group consisting of C_1-C_{20} alkyl, C_2-C_{20} alkenyl, C_2-C_{20} alkynyl, aryl, C_1-C_{20} carboxylate, C_1-C_{20} alkoxy, C_2-C_{20} alkenyloxy, C_2-C_{20} alkynyloxy, aryloxy, C_2-C_{20} alkoxycarbonyl, C_1-C_{20} alkylthiol, aryl thiol, C_1-C_{20} alkylsulfonyl and C_1-C_{20} alkylsulfinyl, the substituent optionally substituted with one or more moieties selected from the group consisting of C_1-C_{10} alkyl, C_1-C_{10} alkoxy, aryl, and a functional group selected from the group consisting of hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen.

33. The method as in claim 32 wherein:

M is ruthenium;

X and X^1 are each chloride;

L is selected from the group consisting of -P(cyclohexyl)$_3$, -P(cyclopentyl)$_3$, -P(isopropyl)$_3$, and -P(phenyl)$_3$;

R is hydrogen;

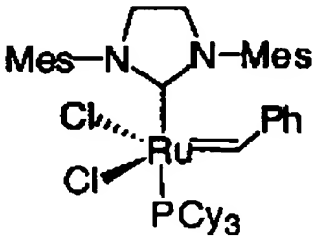
R^1 is phenyl or vinyl, optionally substituted with one or more moieties selected from the group consisting of C_1-C_5 alkyl, C_1-C_5 alkoxy, phenyl, and a functional group selected from the group consisting of hydroxyl, thiol, thioether, ketone, aldehyde, ester,

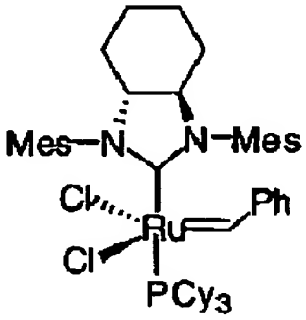
ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen;

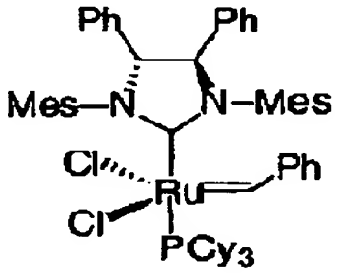
R^6 and R^7 are each independently hydrogen, phenyl, or together form a cycloalkyl or an aryl optionally substituted with one or more moieties selected from the group consisting of C_1-C_{10} alkyl, C_1-C_{10} alkoxy, aryl, and a functional group selected from the group consisting of hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen; and

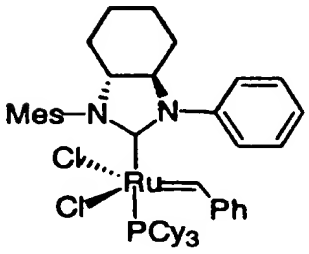
R^8 and R^9 are each is independently C_1-C_{10} alkyl or aryl optionally substituted with C_1-C_5 alkyl, C_1-C_5 alkoxy, aryl, and a functional group selected from the group consisting of hydroxyl, thiol, thioether, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, carbamate, and halogen.

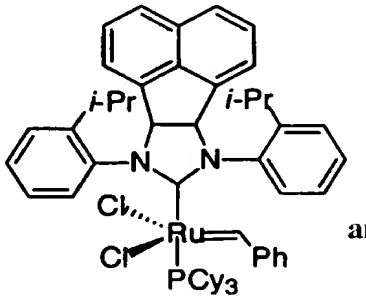
34. The method as in claim 32 wherein the compound is selected from the group consisting of



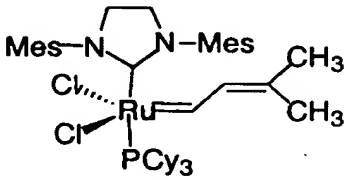








and



35. The method as in claim 33 wherein the olefin is a cyclic olefin.

add B'y